



## Field Simulator for System Testing and Start-Up (SIMCart™)

### *The Challenge*

The Hanford Site has dozens of operating facilities including waste management, waste treatment, and service utilities such as water and steam supply. Several manual systems at Hanford are being automated, and that conversion brings a new set of challenges associated with system validation and testing. Most systems have field components (e.g. control devices, valves, or pressure transmitters) installed in remote pits, below ground vaults or in radiation zones making access more difficult. Automating existing or new facilities includes programmable logic controllers (PLC) and digital control systems (DCS) in centrally located clean areas and requires installation of tens or even hundreds of field located control devices (input/output modules). Testing and validation of the PLC, DCS and associated I/O modules on the field components are time-consuming as the process requires significant manual labor in the field to ensure all components are properly installed and will function as intended. The ability to effectively test these complex systems is reduced with multiple control strategies, numerous input and output devices, and different controllers and networks. The challenge, therefore, was to deploy a technology that could ensure quality acceptance testing of automated systems in a greatly shortened time frame at a reduced cost and reduced risk to the workers.



The SIMCart is used to test the Hanford Water Control System PLC prior to field installation in the 200 Area.

### *Current Approach*

The current method to test automated PLC-based control systems involves cycling each field device through various operating stages to ensure that correct responses occur for all ranges of input and output signals. Signal values must be pre-established for manual input that will simulate automatic operation. Each device is activated through a suitable operating cycle to provide assurance that temperatures, pressures, levels, and valve positions respond correctly as designed. Test input values for each device are entered and the tester looks for system feedback via installed monitoring test instruments, control devices or graphical interface points. Records are maintained including, the tester's name, date, time, and initial data. This process continues for each device and can involve up to a thousand or more test points depending on system sophistication. Stationing multiple personnel at each device or groups of devices to record data and validate instruments and wiring can consume significant manpower for weeks to complete a system. The problem is that the above methods are labor intensive, do not adequately model the exact field

#### *Benefits and Features*

- ◆ Pre-field Testing of PLC/HMI & DCS systems
- ◆ Electronic documentation of test results and exceptions
- ◆ Diagnostic tools to assist in system configuration
- ◆ Repeatable, validated and verified testing
- ◆ Method for simulation and operator certification training

conditions, and are not easily repeatable, especially for present systems that typically require a high degree of validation and verification.

### *New Technology*

SIMCart™ was developed by the Computerized Control and Automation Design (CCAD) team at Fluor Daniel Northwest, providing a novel and cost effective approach to the staging and testing of PLC and DCS systems before delivery to the field. SIMCart™ also provides a very fast and efficient method to test field-wiring connections after installation of the tested system.

SIMCart™ consists of a Programmable Controller connected to a smart Input/Output (I/O) system within the SIMCart™. The SIMCart™ smart I/O are connected to the target PLC or DCS system to be tested in the field via wiring harnesses. The SIMCart™ is then configured to generate field test cases and record the system responses. SIMCart™ becomes the process to simulate both sensors and control elements. All tests are repeatable and form a quality record suitable for auditing purposes.

Instead of the typical method of single point-by-point testing with multiple personnel, an entire system can be tested simultaneously with a minimum amount of configuration time. Connection of multiple SIMCarts can match any size large or complex field system. Simulator packages are able to perform multi-point testing automatically generating an *actual* real time field signal (e.g. 4 to 20 milliamp), test actual field device signal responses from the installed system, and provide a finished set of test reports formatted for Quality Assurance signoff.

Current point-by-point testing methods require hundreds or even thousands of repetitive manual steps that by their nature propagate mistakes.

SIMCart™ requires an initial configuration of database tables and wire harness connections reducing the actual test period from days or weeks to just hours.

The SIMCart™ has been used successfully on the Saltwell flammable gas qualified exhauster skids for ventilation of high level waste tanks. SIMCart™ ensured that these important systems were thoroughly acceptance-tested before implementation in the field.

The SIMCart™ was also used on the newly installed Hanford Site Water Control System upgrade for the 200 Area. The lead engineer for the project estimates that the SIMCart™ reduced start-up time from a projected 8 to 10 weeks to just eight *days*. SIMCart™ has many applications at Hanford and is currently being marketed off site for widespread use in industry and commercial system installations.

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